इंटरनेट मानक

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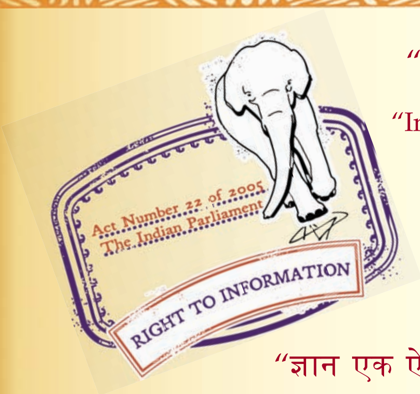

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
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“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक

इलेक्ट्रॉनिकी एवं विद्युतीय मदों के लिए बेसिक पर्यावरण परीक्षण कार्यविधियाँ

भाग 7 संघटट परीक्षण

अनुभाग 7 परीक्षण ईएच : हैमर परीक्षण

Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART 7 IMPACT TEST

Section 7 Test Eh : Hammer Tests

ICS 19.040

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

August 2006 Price Group 11

NATIONAL FOREWORD

This Indian Standard (Part 7/Sec 7) which is identical with IEC 60068-2-75 (1997) 'Environmental testing — Part 2 : Tests — Test Eh : Hammer tests' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Environmental Testing Procedures Sectional Committee and approval of the Electronics and Information Technology Division Council.

The text of the IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60068-1 (1988) Environmental testing — Part 1 : General and guidance	IS 9000 (Part 1) : 1988 Basic environmental testing procedures for electronic and electrical items: Part 1 General (*first revision*)	Technically Equivalent
IEC 60721-1 (1990) Classification of environmental conditions — Part 1 : Environmental parameters and their severities	IS 13736 (Part 1) : 1993 Classification of environmental conditions: Part 1 Classification of environmental parameters and their severities	Identical
ISO 2039-2 : 1987 Plastics — Determination of hardness — Part 2 : Rockwell hardness	IS 13360 (Part 5/Sec 13) : 1992 Plastics — Methods of testing: Part 5 Mechanical properties, Section 13 Determination of Rockwell hardness	Technically Equivalent
ISO 2041 : 1990 Vibration and shock — Vocabulary	IS 11717 : 2000 Vocabulary on vibration and shock (*first revision*)	Identical
ISO 2768-1 : 1989 General tolerances — Part 1 : Tolerances for linear and angular dimensions without individual tolerances indicated	IS 2102 (Part 1) : 1993 General tolerances: Part 1 Tolerances for linear and angular dimensions without individual tolerances indications (*third revision*)	do
ISO 6508 : 1986 Metallic materials — Hardness test — Rockwell test (scales A-B-C-D-E-F-G-H-K)	IS 1586 : 2000 Method for Rockwell hardness test for metallic material (scales A-B-C-D-E-F-G-H-K 15N, 30N, 45N, 15T, 30T and 45T) (*third revision*)	Technically Equivalent

(*Continued on third cover*)

Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART 7 IMPACT TEST

Section 7 Test Eh : Hammer Tests

1 Scope

This part of IEC 60068 provides three standardized and co-ordinated test methods for determining the ability of a specimen to withstand specified severities of impact. It is used, in particular, to demonstrate an acceptable level of robustness when assessing the safety of a product and is primarily intended for the testing of electrotechnical items. It consists of the application to the specimen of a prescribed number of impacts defined by their impact energy and applied in the prescribed directions.

This part of IEC 60068 covers energy levels ranging from 0,14 joules (J) to 50 joules (J).

Three types of test apparatus are applicable to perform these tests. Annex C provides some guidance as to this aspect.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60068. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 60068 should investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60068-1: 1988, *Environmental testing – Part 1: General and guidance*

IEC 60721-1: 1990, *Classification of environmental conditions – Part 1: Environmental parameters and their severities*
Amendment 1, 1992

ISO 1052: 1982, *Steels for general engineering purposes*

ISO 2039-2: 1987, *Plastics – Determination of hardness – Part 2: Rockwell hardness*

ISO 2041: 1990, *Vibration and shock – Vocabulary*

ISO 2768-1: 1989, *General tolerances – Part 1: Tolerances for linear and angular dimensions without individual tolerances indicated*

ISO 6508: 1986, *Metallic materials – Hardness test – Rockwell test (scales A – B – C – D – E – F – G – H – K)*

3 Provisions common to all hammer test methods

3.1 *Definitions*

For the purpose of this part of IEC 60068, the terms used are generally defined in ISO 2041 or in IEC 60068-1. The following additional common definitions are also applicable for the purpose of this part of IEC 60068. Definitions specific to the tests of clauses 4 and 6 are given therein.

3.1.1 **fixing point:** Part of the specimen in contact with the mounting fixture at the point where the specimen is normally fastened in service.

3.1.2 **equivalent mass:** Mass of the striking element and any relevant portions of the test apparatus which, combined with its velocity, provides the impact energy.

NOTE – For the particular application to the pendulum hammer apparatus, see 4.1.3.

3.2 *Severities*

3.2.1 *General*

The severity is defined by the impact energy value chosen from 3.2.2, and the number of impacts according to 3.2.3.

3.2.2 *Impact energy value*

The impact energy value shall be one of the following, as prescribed by the relevant specification:

0,14 – 0,2 – (0,3) – 0,35 – (0,4) – 0,5 – 0,7 – 1 – 2 – 5 – 10 – 20 – 50 joules.

NOTE – Figures in brackets appear in current IEC 60068-2 standards, but will be removed five years from the date of publication of this standard.

3.2.3 *Number of impacts*

Unless otherwise prescribed by the relevant specification, the number of impacts shall be three per location.

3.3 *Test apparatus*

3.3.1 *Description*

Three types of test apparatus are available to perform these tests:

- the pendulum hammer;
- the spring hammer;
- the vertical hammer.

The types of test apparatus are defined in clauses 4, 5 and 6 as tests Eha, Ehb and Ehc respectively. The co-ordinated characteristics of the striking element are, in principle, similar in all three cases and are stated in table 1, in relation to the outline shown in figure 1.

Dimensions are in millimetres. Tolerances are as per class m of ISO 2768-1, unless otherwise stated.

Table 1 – Co-ordinated characteristics of the striking elements

Energy value J.	≤1 ±10 %	2 ±5 %	5 ±5 %	10 ±5 %	20 ±5 %	50 ±5 %
Equivalent mass ±2% kg	0,25 (0,2)	0,5	1,7	5	5	10
Material	Polyamide[1]	Steel[2]				
R mm	10	25	25	50	50	50
D mm	18,5 (20)	35	60	80	100	125
f mm	6,2(10)	7	10	20	20	25
r mm	–	–	6	–	10	17
l mm	To be adjusted to match the equivalent mass, see annex A.					

[1] 85≤HRR≤100, Rockwell hardness according to ISO 2039-2.

[2] Fe 490-2, according to ISO 1052: Rockwell hardness: HRE 80...85 according to ISO 6508.

NOTE – The values shown in brackets for the equivalent mass and the diameter of the striking element for the energy value equal to or less than 1 J are those in the current test Ef. The values currently in test Eg are also shown for these two parameters. For co-ordination purposes, the values in brackets will be deleted five years from the publication of this standard.

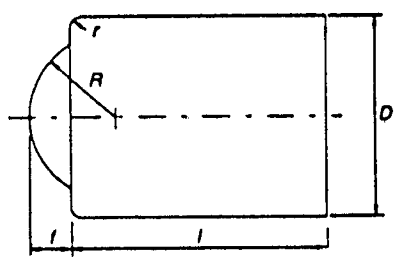


Figure 1 – Example sketch of a striking element

The striking surface shall be visually examined before each impact in order to ensure that there is no damage that might affect the result of the test.

3.3.2 *Mounting*

As prescribed by the relevant specification, the specimen shall either:

a) be mounted by its normal means on a rigid plane support, or

b) be placed against a rigid plane support.

In order to ensure that the specimen is rigidly supported, it may be necessary when performing the test to place the specimen against a plane solid support, for example a wall or a floor made of brick or concrete, covered by a sheet of polyamide which is tightly fixed to the support.

Care shall be taken to ensure that there is no appreciable air gap between the sheet and the support. The sheet shall have a Rockwell hardness of $85 \leq HRR \leq 100$ according to ISO 2039-2, a thickness of approximately 8 mm and a surface area such that no parts of the specimen are mechanically over stressed due to the supporting area being insufficient.

The mounting arrangement is deemed to be sufficiently rigid if the displacement of the impact surface of the plane support does not exceed 0,1 mm when struck by an impact applied directly to it with the same level of energy as for the specimen.

NOTES

1 For specimens to be subjected to impact energies not exceeding 1 J, some examples of mounting and support are shown in figures D.3, D.4 and D.5.

2 When the mass of the mounting is at least 20 times that of the specimen, the rigidity of the mounting is likely to be sufficient.

3.4 *Preconditioning*

The relevant specification may call for preconditioning and shall then prescribe the conditions.

3.5 *Initial measurements*

The specimen shall be submitted to the visual, dimensional and functional checks prescribed by the relevant specification.

3.6 *Testing*

Secondary impacts, i.e. rebounds, shall be avoided.

3.6.1 *Attitudes and impact locations*

The relevant specification shall prescribe the attitudes of the specimen and the locations on the specimen, corresponding to where damage is most likely to occur in practice, and at which the impacts are to be applied. Unless otherwise specified by the relevant specification, the blows shall be applied perpendicularly to the tested surface.

3.6.2 *Preparation of the specimen*

The relevant specification shall state any requirements for the securing of bases, covers, and similar items before the specimen is subjected to the impacts.

NOTE – Account may need to be taken of requirements for functional monitoring (see 3.6.3b).

3.6.3 *Operating mode and functional monitoring*

The relevant specification shall state:

a) whether the specimen is required to operate during impact;

b) whether any functional monitoring is required.

In both cases the relevant specification shall provide the criteria upon which the acceptance or rejection of the specimen is to be based.

NOTE – Attention is drawn to the fact that, in case of breakage of the specimen, internal parts may become hazardous.

3.7 *Recovery*

The relevant specification may call for recovery and shall then prescribe the conditions.

3.8 *Final measurements*

The specimen shall be submitted to the visual, dimensional and functional checks prescribed by the relevant specification.

The relevant specification shall prescribe the criteria upon which the acceptance or rejection of the specimen is to be based.

3.9 *Information to be given in the relevant specification*

When one of the tests in this part of IEC 60068 is included in a relevant specification, the following details shall be given as far as they are applicable, paying particular attention to the items marked with an asterisk (*) as this information is always required:

	Subclause
a) Impact energy *	3.2.2
b) Number of impacts, if other than three per location	3.2.3
c) Type(s) of test apparatus to be used	3.3.1
d) Method of mounting *	3.3.2
e) Preconditioning	3.4
f) Initial measurements*	3.5
g) Attitude and impact locations *	3.6.1
h) Securing of bases, covers and similar components	3.6.2
i) Operating mode and functional monitoring*	3.6.3
j) Acceptance and rejection criteria *	3.6.3 and 3.8
k) Conditions for recovery	3.7
l) Final measurements*	3.8

4 Test Eha: Pendulum hammer

4.1 *Definitions*

The following additional terms and definitions are applicable for the purpose of this test method.

4.1.1 **measuring point:** Point marked on the surface of the striking element where the line through the point of intersection of the axes of the arms of both of the pendulum and of the striking element, and perpendicular to the plane through both axes, meets the surface (see figure 2).

NOTES

1 In some IEC standards which include a pendulum hammer test, the term "checking point" has been used but it has not been used here in order to avoid confusion with "check point " in other parts of IEC 60068-2.

2 Theoretically, the centre of gravity of the striking element should be the measuring point. In practice, the centre of gravity is either difficult to determine or inaccessible, and the measuring point is therefore defined as above.

4.1.2 **height of fall:** Vertical distance between the position of the measuring point when the pendulum is released and its position at the moment of impact (see figure D.1).

4.1.3 **equivalent mass:** The mass of the simple pendulum hammer calculated from the measure of the vertical force (in newtons) to be applied in the axis of the striking element to maintain the arm of the pendulum in a horizontal position, divided by the earth's gravity.

NOTE – When the mass of the arm is evenly distributed, the equivalent mass is equal to the sum of the combined mass of the striking element plus half the mass of the arm.

4.1.4 **combined mass of the striking element:** The sum of the masses of the striking element and of the element's fixing system.

4.2 *Test apparatus*

The test apparatus consists basically of a pendulum rotating at its upper end in such a way as to be kept in a vertical plane. The axis of the pivot is at 1000 mm above the measuring point. The pendulum is composed of a nominally rigid arm and of a striking element complying with the requirements of table 1.

For testing heavy, voluminous or difficult to handle specimens, a portable pendulum may be used. It shall comply with the above description but its pivot may be fixed directly on the specimen or on a movable structure. In this case, it shall be ensured that, before the tests, the axis of the pendulum is horizontal, that its fixing is sufficiently rigid, and that the impact point is in the vertical plane passing through the axis.

In all cases, when the pendulum is released, it shall be allowed to fall only under the influence of gravitational force.

4.2.1 *Test apparatus for severities not exceeding 1 J*

The striking element comprises a steel body with a polyamide insert having a hemispherical face. Its combined mass is 200 g (150 g) ± 1 g so that the equivalent mass complies with table 1. Annex D gives an example of a test apparatus.

4.2.2 *Test apparatus for severities of 2 J and above*

The ratio of the mass of the arm to the combined mass of the striking element shall not be greater than 0,2 and the centre of gravity of the striking element shall be as close as is practicable to the axis of the arm.

NOTE – For some particular applications the pendulum arm is replaced by a cord and the striking element by a spherical steel ball. This is not recommended as the ball does not conform to the geometry of the striking element specified in this part of IEC 60068.

4.3 *Height of fall*

To produce impacts of the required severity, the striking element shall be released from a height depending on the equivalent mass of the pendulum, according to table 2.

Table 2 – Height of fall

Energy J	0,14	0,2		(0,3)	0,35	(0,4)	0,5		0,7	1	2	5	10	20	50
Equivalent mass kg	0,25	(0,2)	0,25	(0,2)	0,25	(0,2)	(0,2)	0,25	0,25	0,25	0,5	1,7	5	5	10
Height of fall mm ± 1 %	56	(100)	80	(150)	140	(200)	(250)	200	280	400	400	300	200	400	500

NOTES

1 See note in 3.2.2.

2 In this part of IEC 60068, the energy, J, is calculated taking the standard acceleration due to the earth's gravity (g_n), rounded up to the nearest whole number, that is 10 m/s².

4.4 *Testing*

In order to avoid secondary impacts, i.e. rebounds, the hammer shall be retained after the initial impact by grasping the striking element whilst avoiding the arm so that distortion is prevented.

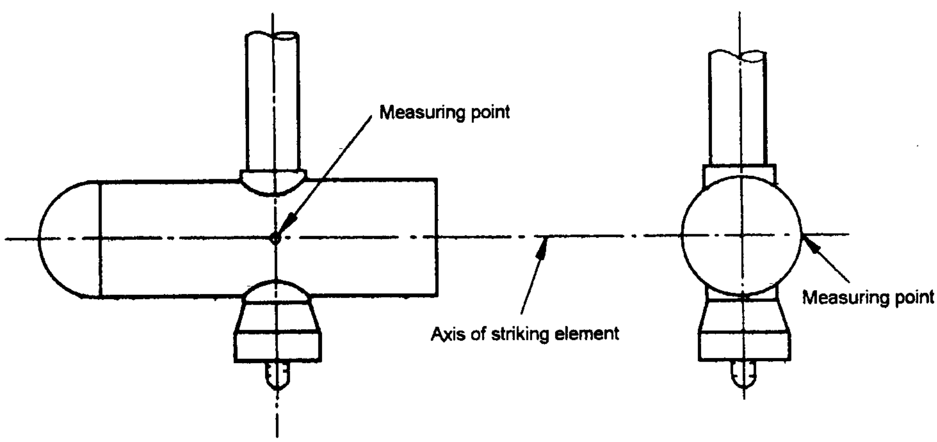


Figure 2 – Derivation of measuring point

5 Test Ehb: Spring hammer

5.1 *Test apparatus*

The spring hammer consists of three principal parts: the body, the striking element and the release system.

The body comprises the housing, the guide for the striking element, the release mechanism and all parts rigidly fixed thereto.

The striking element comprises the hammer head, the hammer shaft and the cocking knob. The mass of this assembly is 250 g for severities not exceeding 1 J, and 500 g for 2 J (see table 1 for tolerances).

The pressure to release the striking element shall not exceed 10 N.

The configuration of the hammer shaft, the hammer head and the means for the adjustment of the hammer spring is such that the hammer spring has released all its stored energy approximately 1 mm before the tip of the hammer head reaches the plane of impact. For the last millimetre of its travel, prior to impact, the striking element is thus, apart from friction, a freely moving mass having only kinetic energy and no stored energy. Moreover, after the tip of the hammer head has passed the plane of impact, the striking element is free to travel, without interference, over a further distance of between 8 mm and 12 mm. Annex E gives an example of a test apparatus.

In order to comply with table 1, the shape of the release head for 2 J shall be cylindrical for a length of 23 mm with a diameter of 35 mm (see figure 3).

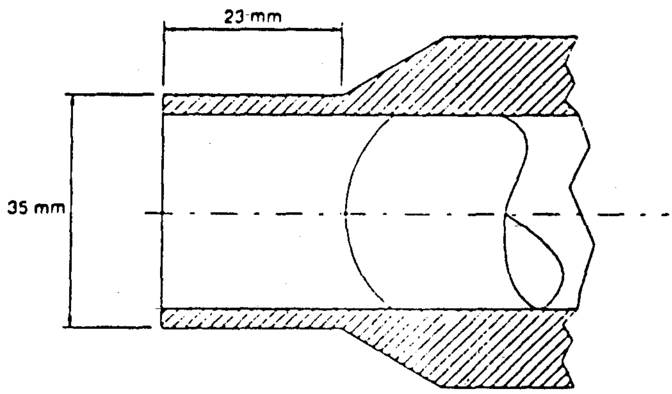


Figure 3 – Shape of release head for 2 J

5.2 *Influence of earth's gravity*

When the spring hammer is used in a position differing from the horizontal, the energy, J, actually delivered is modified by ΔE. This variation is positive when the blows are applied downward, and negative when applied upward.

$$\Delta E = 10 \times m \times d \times \sin \alpha$$

where

m is the mass of the striking element, in kilogrammes;

d is the travel of the striking element inside the spring hammer, in metres;

α is the angle of the axis of the striking element with the horizontal.

This variation shall be taken into account when establishing the actual energy delivered.

5.3 *Calibration*

The spring hammer shall be calibrated. Annex B gives a standardized preferred procedure (see B.2 in particular for 2 J). Other methods of calibration may also be used, provided that evidence is available that they give equivalent accuracy.

6 Test Ehc: Vertical hammer

6.1 *Definition*

The definition of "height of fall" given in 4.1.2 is applicable.

6.2 *Test apparatus*

The hammer consists basically of a striking element which falls freely from rest through a vertical height, selected from table 2, on to the specimen surface held in a horizontal plane. The characteristics of the striking element shall comply with table 1. The fall of the striking element shall be along a guideway, for example a tube, with negligible braking. This guideway shall not rest on the specimen and the striking element shall be free of the guideway on striking the specimen. In order to reduce the friction, the length *l* of the striking element shall not be smaller than its diameter *D*, and a small gap (for example 1 mm) shall be provided between the striking element and the guideway.

6.3 *Height of fall*

The height of fall shall be as given in table 2, the equivalent mass stated therein being equal to the actual mass of the striking element.

Annex A
(normative)

Shapes of striking elements

These figures show the characteristics defined in table 1. It is important to note that lengths *l* are calculated for pendulum hammers with arms of negligible mass or for vertical hammers. When this mass cannot be neglected, it shall be reduced so that the equivalent mass meets the requirements of table 1 (see 4.1.3). To comply with the other parameters of table 1, it is necessary to hollow out the end opposite to the striking face for 20 J and 50 J.

Every edge shall be smoothed.

Dimensions in millimetres. Tolerances as per class m of ISO 2768-1, unless otherwise stated.

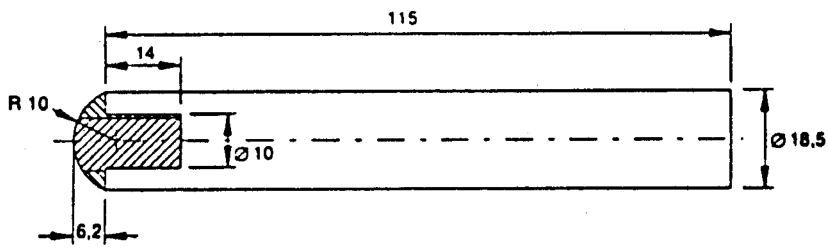


Figure A.1 – Example of a striking element for ≤ 1 J

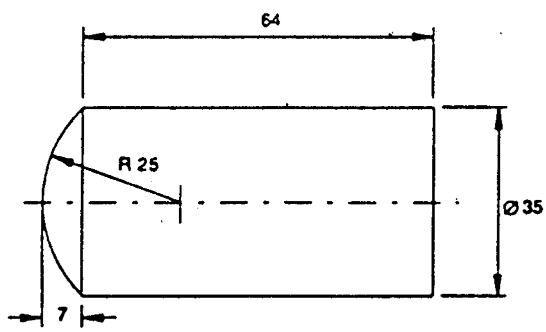


Figure A.2 – Example of a striking element for 2 J

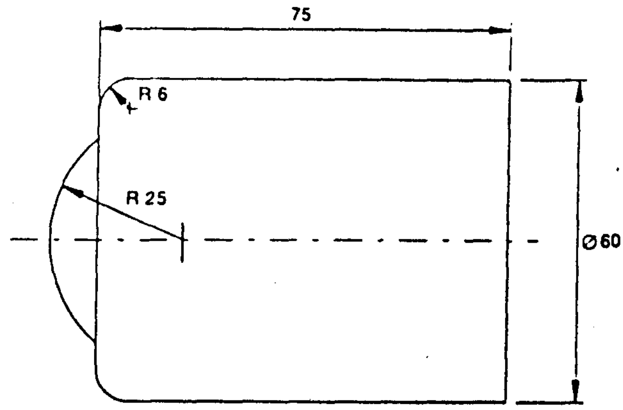


Figure A.3 – Example of a striking element for 5 J

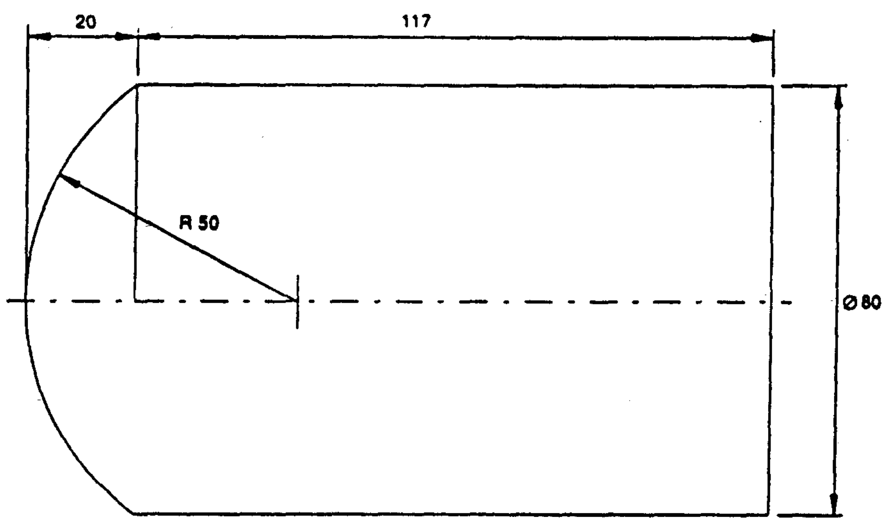


Figure A.4 – Example of a striking element for 10 J

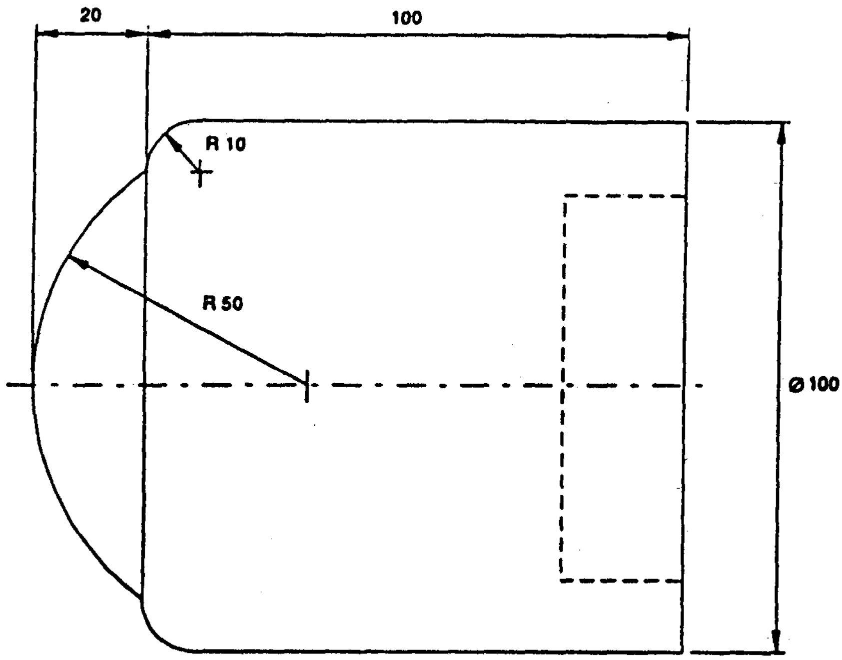


Figure A.5 – Example of a striking element for 20 J

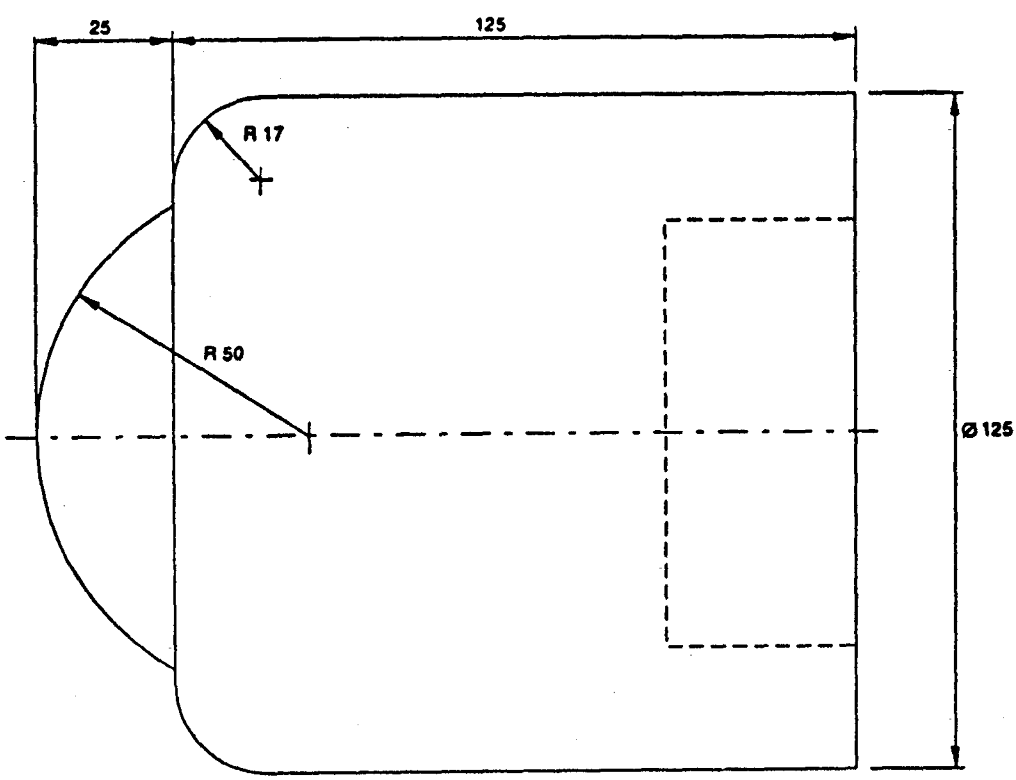


Figure A.6 – Example of a striking element for 50 J

Annex B
(normative)

Procedure for the calibration of spring hammers

B.1 Principle of calibration

The principle of this calibration procedure is to compare the energy provided by a spring hammer, which is difficult to measure directly, to the energy of a pendulum, calculated from its mass and height of fall.

B.2 Construction of the calibration device

The assembled calibration device is shown in figure B.1. Apart from the frame, the main parts are a bearing "a", a drag pointer "b", a pendulum "c", a release base "d" and a release device "e".

The main part of the calibration device is the pendulum "c" shown in figure B.2. To the lower end of this pendulum is fixed a steel spring with the details shown in figure B.3. The spring is of spring steel, requiring no special treatment, and is rigidly fixed to the pendulum "c".

Figure B.4 shows some parts on a larger scale

It should be noted that this spring is designed for calibrating spring hammers having characteristics as defined in table 1 for energy values equal to or less than 1 J. For calibrating spring hammers having characteristics as defined for 2 J, the spring of the pendulum of the calibrating device would need to be of a different design.

In order to obtain suitable friction characteristics of the pointer, a piece of thick woven cloth is placed between the metal surfaces of the bearing, the piano wires being bent in such a way that a small force is exerted against the cloth.

Because the release device is removed during the calibration of the calibration device, the release device is fixed to the release base by means of screws.

B.3 Method of calibration of the calibration device

The calibration of the calibration device is effected by using a calibration striking element "g" taken from a spring-hammer, as shown in figure B.5. Before calibration, the release device is removed from the calibrating device.

The calibration striking element is suspended by four linen threads "h" from suspension points situated in a horizontal plane, 2 000 mm above the point of contact between the pendulum and the calibration striking element when the latter is in its rest position. The calibration striking element is allowed to swing against the pendulum and the point of contact under dynamic conditions, point "k", shall be not more than 1 mm below the point of contact in the rest position. The suspension points are then raised over a distance equal to the difference between both contact points.

When the suspension system is adjusted, the axis of the calibration striking element "g" shall be at right angles to the impact surface of the pendulum "c" and the calibration striking element shall be horizontal at the moment of impact.

When the calibration striking element is in its rest position, the calibration device is placed so that point "k" is positioned exactly at the head of the calibration striking element.

To obtain reliable results, the calibration device is rigidly fixed to a massive support, for example to a structural part of a building.

The height of fall is measured at the centre of gravity of the calibration striking element and the measurement can be facilitated by using a liquid level device consisting of two glass tubes "j", which are interconnected by means of a flexible hose. One of the glass tubes is fixed and provided with a scale "l".

The calibration striking element may be held in its upper position by means of a thin thread "m" which, when ruptured, causes the release of the calibration striking element.

For scaling the calibration device, a circle is drawn on the scale plate, the centre of this circle coinciding with the bearing of the pendulum and its radius being such that the circle extends to the drag pointer. On this circle, the zero point 0 J shown in figure B.6 is marked at the point indicated by the drag pointer when the latter is brought into contact with the pendulum in the rest position.

The calibration is made with an impact energy of 1 J, which is achieved with a height of fall of 408 mm ± 1 mm, with a calibration striking element of 250 g.

The point on the scale plate corresponding to 1 J is obtained by allowing the suspended calibration striking element to swing against the point "k" on the spring of the pendulum. After hitting the pendulum, the calibration striking element shall not move. The operation is repeated at least 10 times and the 1 J point is the average of the indications of the drag pointer.

The other points of the scale are then determined as follows:

a) a straight line is drawn through the centre of the circle and the 0 J point;

b) the orthogonal projection of the 1 J point on this line is indicated by P;

c) the distance between the points 0 J and P is divided into 10 equal parts;

d) through each dividing point, a line is drawn perpendicular to the line 0 J-P;

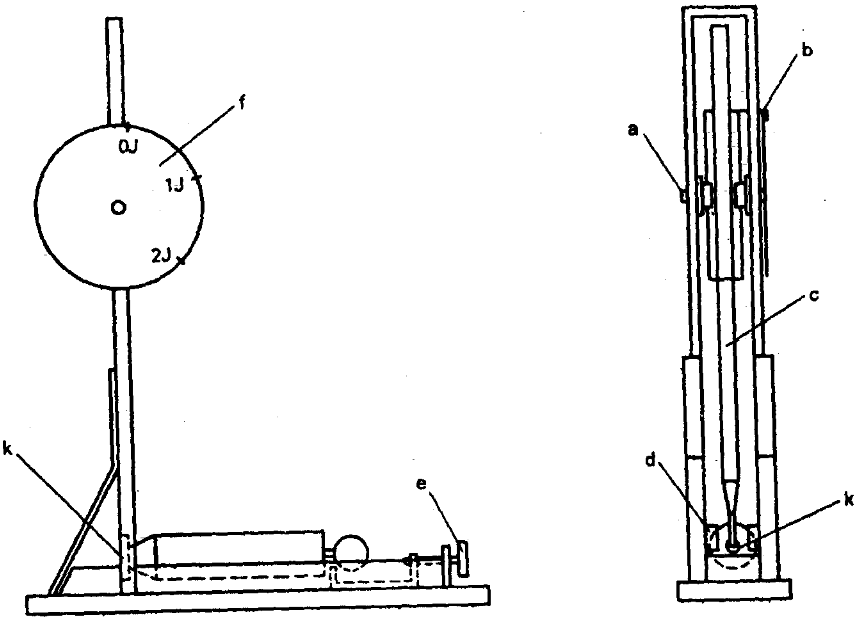
e) the intersections between these lines and the circle correspond to values of impact energy equal to 0,1 J; 0,2 J; up to 0,9 J.

The same principle can be used for extending the scale beyond the 1 J point. The division of the scale plate "f" is shown in figure B.6.

B.4 Use of the calibration device

The spring hammer to be calibrated is put in the release base and is then operated three times by means of the release device; it shall not be released manually.

For each operation, the striking element of the spring hammer to be calibrated is turned in a different position. The average value of the three readings on the calibration device is taken to be the actual value of the impact energy of the specimen.



a = bearing
b = drag pointer
c = pendulum
d = release base
e = release device
f = scale plate
k = point where blows are applied, i.e. impact point

Figure B.1 – Calibration device

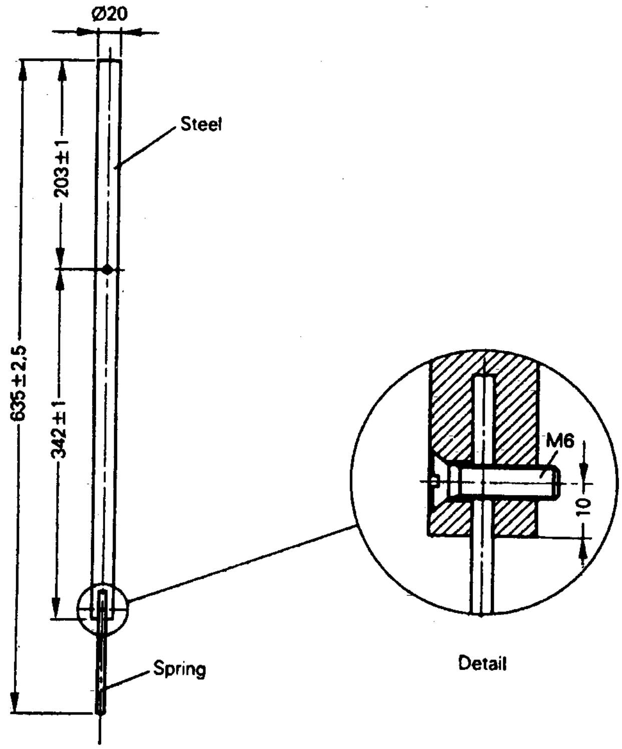


Figure B.2 – Pendulum "c"

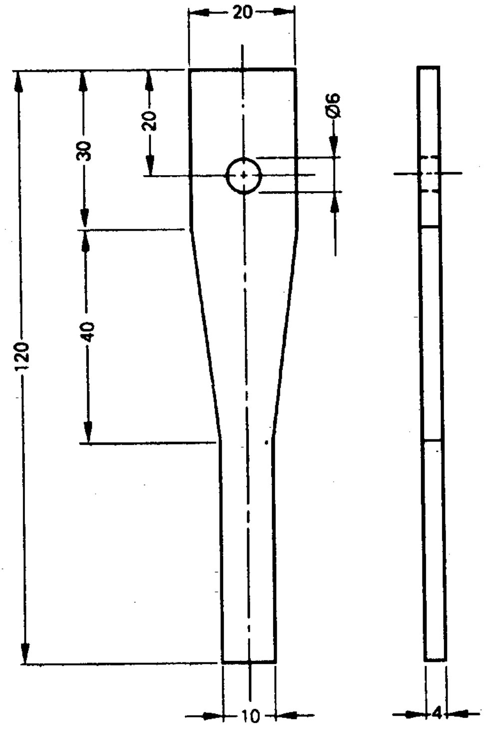


Figure B.3 – Steel spring of pendulum "c"

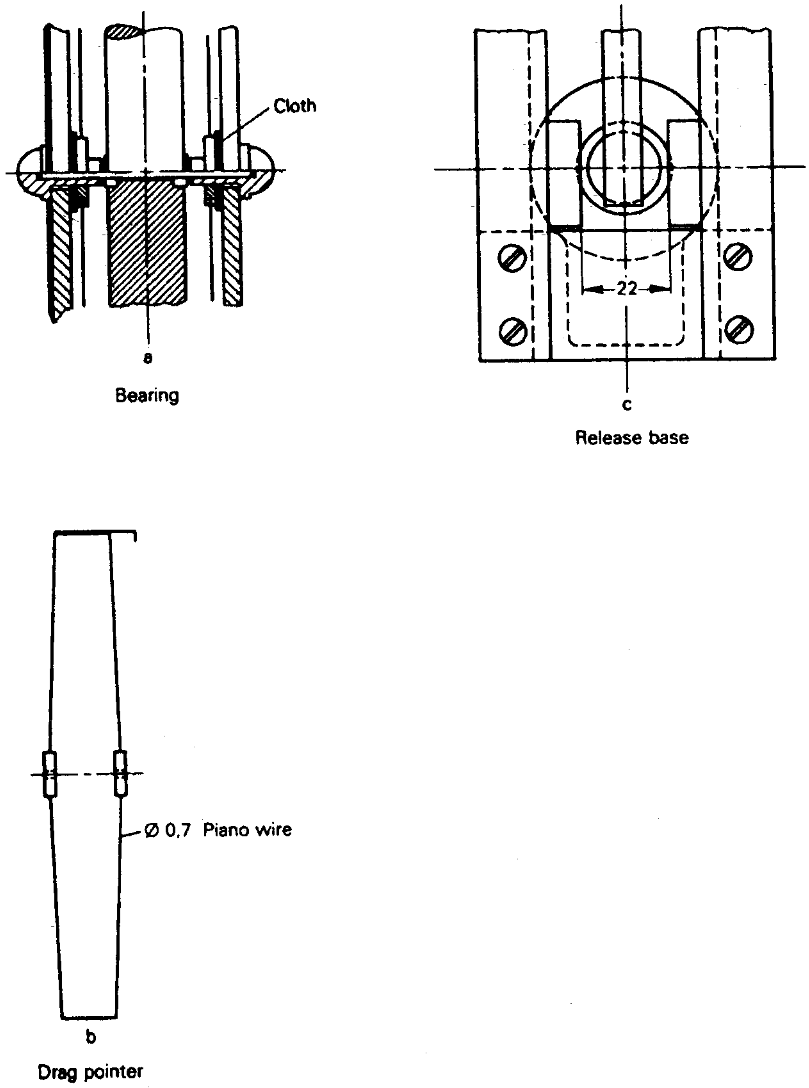
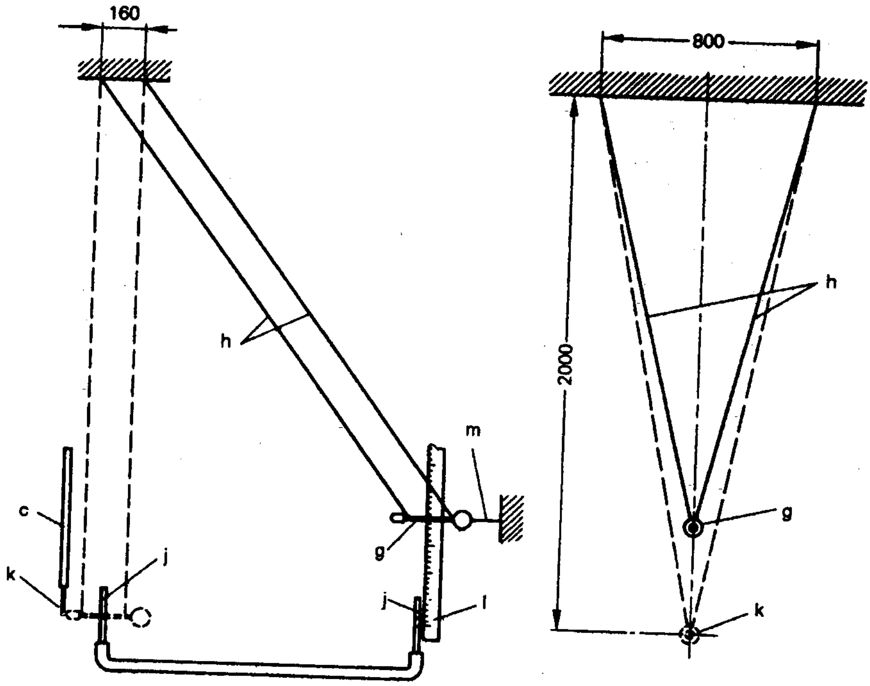


Figure B.4 – Details of calibration device



c = pendulum of figure B.1
g = calibration striking element
h = linen threads
j = glass tubes
k = impact point
l = scale
m = thin thread

For clarity only the pendulum "c" of the calibration device is shown in this figure.

Figure B.5 – Arrangement for the calibration of the calibration device

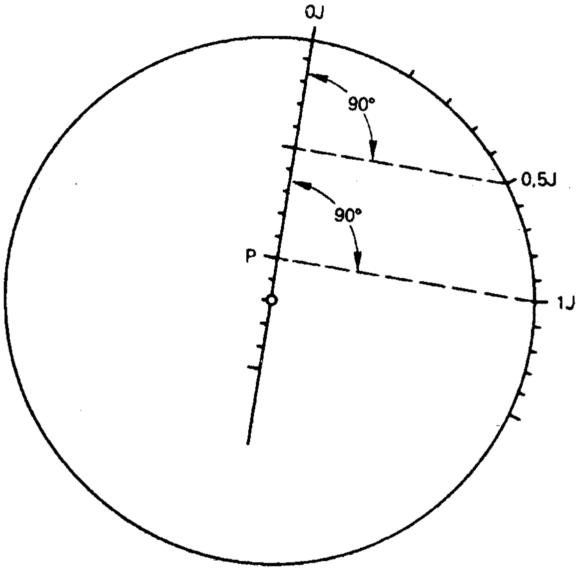


Figure B.6 – Division of scale plate "f"

Annex C
(informative)
Guidance

C.1 When is an impact test appropriate ?

An impact test is appropriate for equipment likely to be used in areas with non-restricted access and where impacts are likely to occur. For equipment destined for areas with restricted access, an impact test may be appropriate but is likely to be of a lower severity.

It is particularly applicable when the equipment is of a brittle nature.

C.2 Choice of the test apparatus

This part of IEC 60068 provides for three methods of test which, as far as is practicable, are intended to give similar results. To obtain repeatable and reproducible results, this test is more dependent on the details of the test apparatus than is usual in IEC 60068 standards.

The choice of the test apparatus depends on the orientation of the surface to be tested and on the energy level. Not all methods can be used in every case. It is self-evident that a pendulum hammer can only be used on vertical surfaces without overhangings. Similarly the vertical hammer can normally only be used on accessible horizontal surfaces. When the specimen cannot be moved or turned, for any reason, the choice is limited. The advantage of the spring hammer is that it can be used in any position, provided there is enough room to apply it correctly, and that the specified impact energy does not exceed 2 J. For higher energy levels, a spring hammer would be too difficult to handle, and could even be hazardous for the operator.

C.3 Choice of the energy level

The energy of impacts depends on the mass of the striking object and its speed, which may be generated by its fall. The following table C.1 gives theoretical energy levels which approximate to values given in this part of IEC 60068.

Table C.1 – Energy levels in joules

Height of fall m	Speed m/s	Mass of striking object kg					
		0,1	**0,2**	**0,5**	**1**	**2**	**5**
0,1	1,4	0,1	0,2	0,5	1	2	5
0,2	2	0,2	0,4	1	2	4	10
0,5	3,1	0,5	1	2,5	5	10	25
1	4,4	1	2	5	10	20	50

The values of table C.1 correspond to blows perpendicular to the specimen surface.

Much higher energies can be encountered in particular situations such as vandalism or in a car accident. In these cases, consideration should be given to the use of additional protection such as barriers or walls.

C.4 Information for testing

The temperature of the specimen may influence the results of the tests and the relevant specification should take this into account when applicable.

Impact tests can be specified in sequence with other tests, but attention is drawn to the fact that some standardized tests are required to be performed on new specimens, which excludes previous hammer tests.

The main performance criteria should be derived from how the operational and survival characteristics of the specimen are influenced by mechanical impacts.

The other important aspect is safety, which can be the prime consideration in certain circumstances.

Annex D
(informative)

Example of pendulum hammer test apparatus

Figure D.1 shows an example of a pendulum hammer test apparatus for energies not exceeding 1 J. The striking element complies with 4.2.1 and figure D.2. The arm is a steel tube with an external diameter of 9 mm (nominal), and a wall thickness of 0,5 mm (nominal).

The specimens are mounted on a sheet of plywood 8 mm thick and 175 mm square, preferably according to ISO 1098*, secured at its top and bottom edges to a rigid bracket, which is part of the mounting fixture, as shown as an example in figure D.3. The mounting fixture has a mass of 10 kg ± 1 kg and is mounted on a rigid frame by means of pivots. The frame is itself fixed to a solid wall.

The design of the mounting is such that

a) the specimen can be so placed that the point of impact lies in the vertical plane through the axis of the pendulum pivot;

b) the specimen can be moved horizontally and turned about an axis perpendicular to the surface of the plywood;

c) the plywood can be turned about a vertical axis.

The specimens are mounted on the plywood as in normal service. Where it is not possible to mount the specimen directly on the plywood, a suitable adapter would need to be prescribed by the relevant specification. An example of an adapter for flush-type switches is shown in figure D.4, and an example of an adapter for lamp holders is shown in figure D.5.

* ISO 1098: 1975, *Veneer plywood for general use – General requirements.*

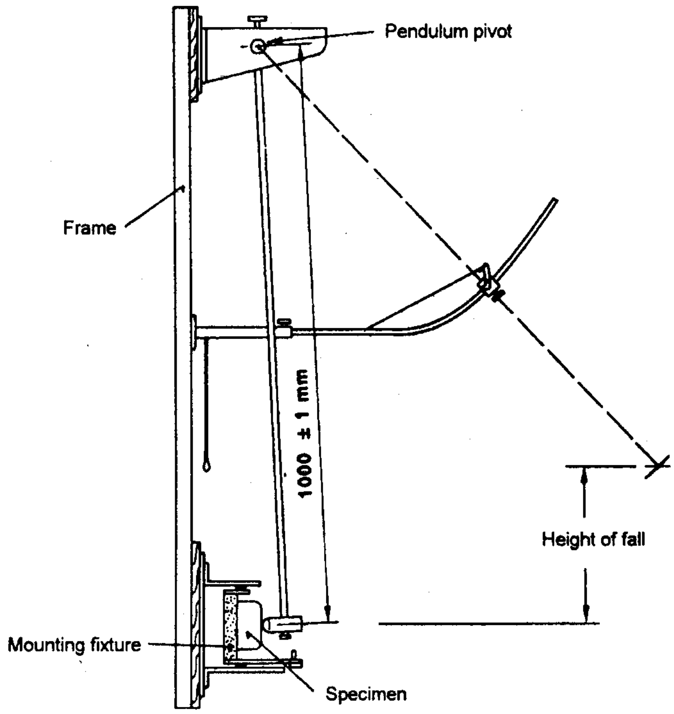
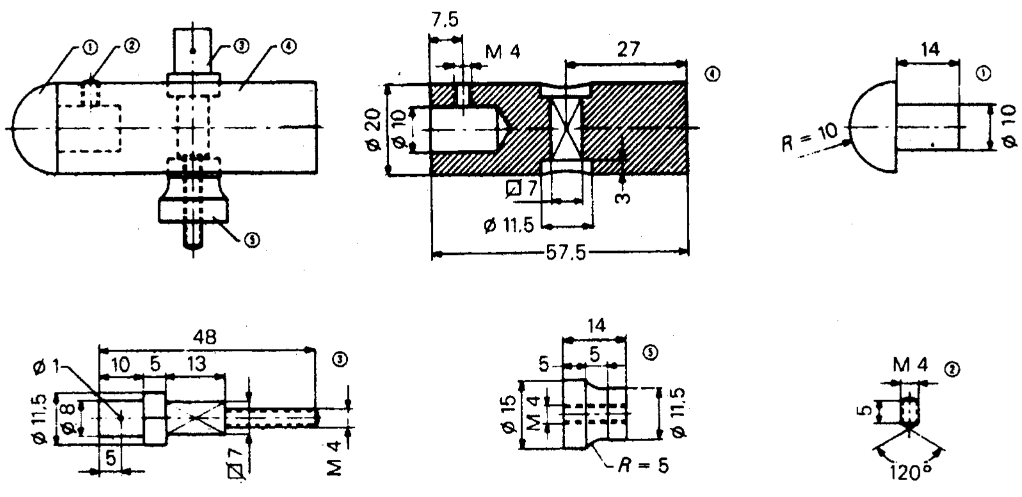


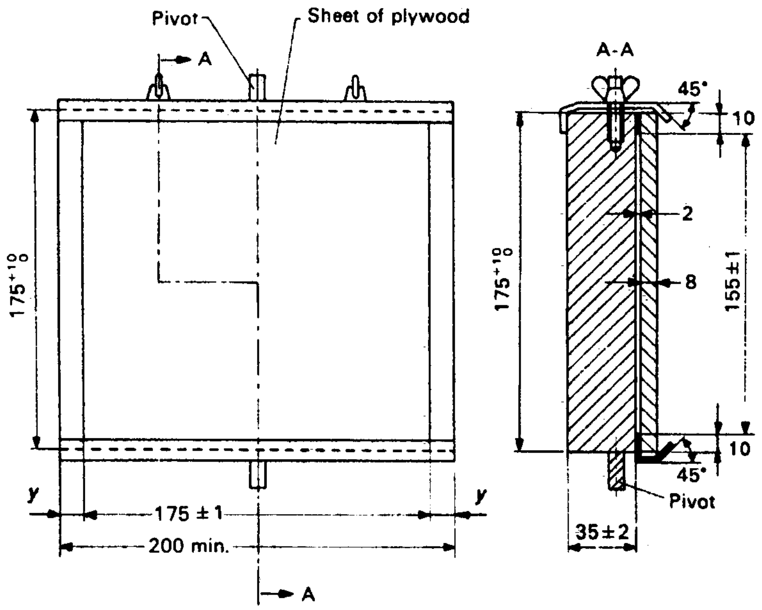
Figure D.1 – Test apparatus



Note – See table 1

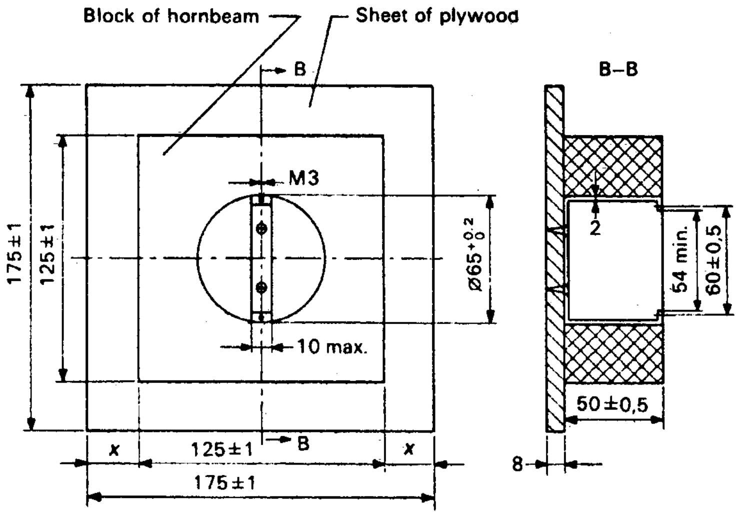
Dimensions in millimetres

Figure D.2 – Striking element of the pendulum hammer for energies ≤ 1 J



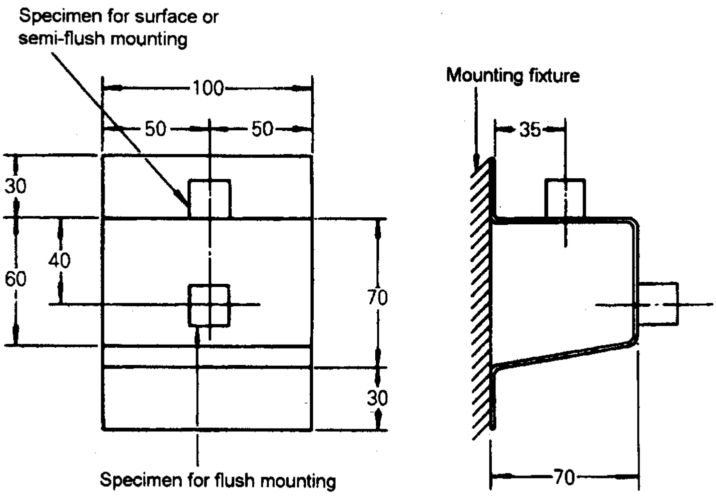
Dimensions in millimetres

Figure D.3 – Mounting fixture



Dimensions in millimetres

Figure D.4 – Adapter for flush-type switches



Dimensions in millimetres

Figure D.5 – Adapter for lamp holders

Annex E
(informative)

Example of spring hammer test apparatus

Figure E.1 shows an example of a spring hammer test apparatus complying with clause 5, for energies not exceeding 1 J. The mass of the body assembly is 1250 g ± 10 g. The hammer head is fixed to the hammer shaft in such a way that the distance from its tip to the plane of impact (the plane of the cone truncation), when the striking element is on the point of release, has approximately the value shown for the spring compression in table E.1.

Table E.1 – Kinetic energy of striking element

Kinetic energy (E) just before impact J	Approximate spring compression with spring constant of $2,75 \times 10^3$ N/m mm
0,14 ± 0,014	10
0,20 ± 0,02	13
0,35 ± 0,03	17
0,50 ± 0,04	20
0,70 ± 0,05	24
1,00 ± 0,05	28

NOTE – The approximate value of the kinetic energy in joules, just before the impact, can be calculated from the following formula:

$$E = 0,5\ FC \times 10^{-3}$$

where

F is the force exerted by the hammer spring, when fully compressed, in newtons;

C is the compression of the hammer spring, in millimetres

The energy stated above is achieved in the horizontal position.

The cone has a mass of approximately 60 g and the cone spring is such that it exerts a force of approximately 5 N when the release jaws are on the point of releasing the striking element. The release mechanism springs are adjusted so that they exert just sufficient pressure to keep the release jaws in the engaged position.

The apparatus is cocked by pulling the cocking knob back until the release jaws engage with the groove in the hammer shaft. The release cone of the test apparatus is pushed against the prescribed position(s) on the specimen perpendicular to the surface of the specimen. The pressure is slowly increased so that the cone moves back relative to the body of the apparatus until it is in contact with the release bars, which then move to operate the release mechanism and allow the hammer to strike the specimen.

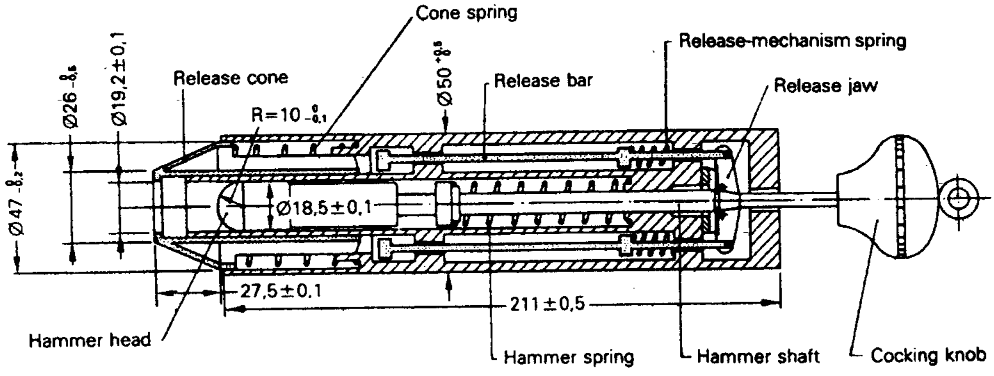


Figure E.1 – Spring hammer test apparatus

(*Continued from second cover*)

The technical committee responsible for the preparation of this standard has reviewed the provisions of the following International Standard and has decided that it is acceptable for use in conjunction with this standard:

International Standard	*Title*
ISO 1052 : 1982	Steels for general engineering purposes

Only the English language text in the International Standard has been retained while adopting it in this Indian Standard, and as such the page numbers given here are not the same as in IEC Publication.

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Amend No.	Date of Issue	Text Affected

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